Energy is essential for Europe to function. The challenges of climate change, increasing import dependence and higher energy prices have to be faced by all EU Member States. Today, nuclear power provides one third of the EU's electricity and two thirds of its low-carbon energy[1]. It is also one of the most competitive energy sources, protecting EU economies against raw material price volatility owing to its limited vulnerability to fuel price changes.

Nuclear Energy Factsheets

Is nuclear energy competitive?

The European energy policy needs to address the three energy challenges facing a competitive electricity production[2]:

- Security of supply,
- Limitation of greenhouse gas emissions, and
- Providing affordable energy to consumers.

This factsheet focuses on the economic dimension for evaluating the competitiveness of nuclear power. (The other two challenges are addressed in dedicated factsheets.)

The data are organised according to a common set of energy technology indicators as defined by the Swiss Paul Scherrer Institute[3]. This methodology was also used by the Competitiveness Working Group of the European Nuclear Energy Forum (ENEF)[4].

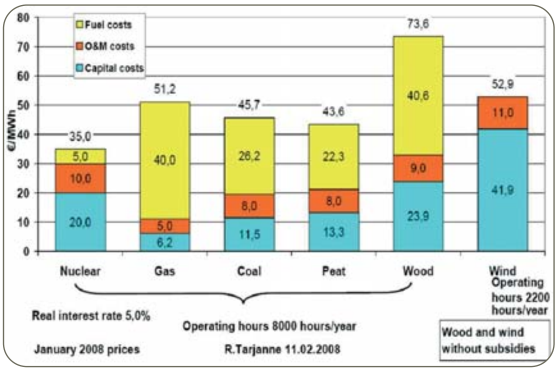
• Production costs

Servicing the construction costs of a nuclear power plant is the most important factor determining the competitiveness of nuclear energy. In spite of the high investment costs (70% of total generation cost for nuclear, as opposed to 40% for coal and 30% for gas), nuclear power plants compete favourably with fossil-fuelled units[5]. Competitiveness would be even more enhanced in the event of an increase in the carbon price and more account taken generally of externalities in energy production[6]. The following examples underline the general trends:

a) Study by Finnish Lappeenranta University of Technology[7]

The calculations are carried out by using the annuity method with a real interest rate of 5 % per annum and a fixed price level as of January 2008.

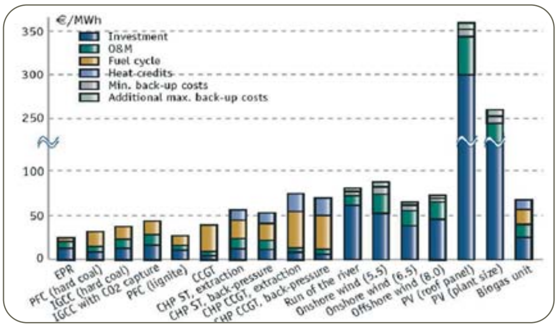
For an annual base-load utilisation time of 8,000 hours (corresponding to a load factor of 91.3 %) the production costs for nuclear electricity would be 35.0 €/MWh.



Electricity generation costs for various technologies (source Lappeenranta University of Technology)

b) Projected costs of generating electricity[8]

The resulting total specific power-generating costs of the power plants considered are shown for Germany as an example in the following figure. The electricity generation costs are calculated with an interest rate of 5% per annum.



Comparison of the power generation costs for various technologies in Germany.

Sensitivity to fuel price increase

Because of their cost structures, the sensitivity of total generation costs to changes in fuel prices varies strongly from one energy source to another. Nuclear fuel production, including uranium mining, enrichment and fuel fabrication, represents only approximately 10-15 % of the total cost of generating nuclear electricity[9]. Therefore a doubling of nuclear fuel prices translates into an increase of only 4% in associated generating costs. This compares with increases of 40% and 75% in the case of the doubling of coal and gas fuel prices, respectively.[10]

Availability (load factor)

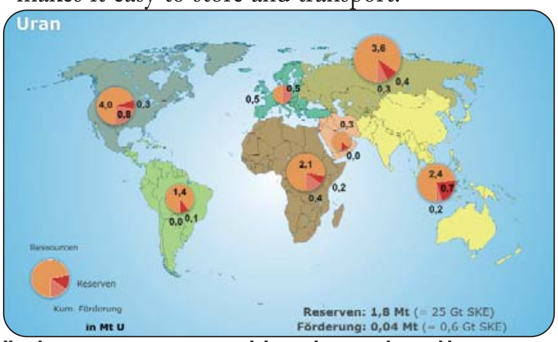
Nuclear and fossil thermal power plants operate at high load factors. The EU-wide average unit availability for nuclear is 84%. The following table, based on the PRIMES model, shows the average power load factor per plant type, based on today's level and prediction for the future[11].

	Avg. Electricity Load Factor (net)						
	2000	2005	2010	2015	2020	2025	2030
Nuclear	0.75	0.80	0.83	0.84	0.84	0.92	0.93
Solid fuels Plants	0.51	0.53	0.59	0.65	0.71	0.73	0.77
Large Gas Plants	0.40	0.47	0.42	0.45	0.45	0.44	0.40
Small gas & oil	0.28	0.26	0.24	0.26	0.30	0.32	0.33
Biomass Plants	0.46	0.58	0.48	0.48	0.55	0.52	0.54
Hydro	0.37	0.32	0.34	0.33	0.33	0.34	0.34
Wind	0.20	0.20	0.23	0.25	0.26	0.26	0.27
Other RES	0.57	0.37	0.26	0.22	0.20	0.19	0.18
Total	0.47	0.48	0.46	0.49	0.49	0.50	0.50

Average electricity load factor for different plant types (Source EC – DG TREN).

Geopolitical factors

As energy demand grows in net importing countries, their energy security is increasingly linked to the effectiveness of international markets of the associated resources and the reliability of their suppliers. The geographical distribution of uranium resources is diverse, with most of them found in politically stable regions of the world[12]. Moreover the high concentration of energy in uranium makes it easy to store and transport.



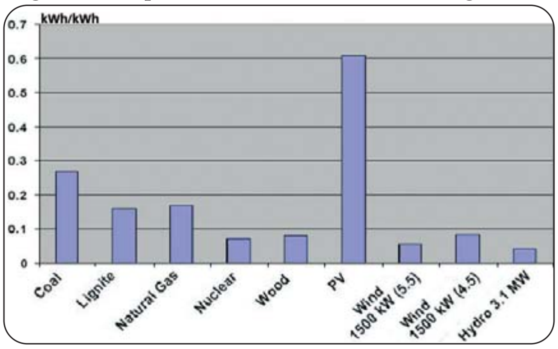
Uranium resources, reserves and demand across the world (Copyright BGR, Hannover 2009)

Long-term resource sustainability

Even though nuclear electricity prices are highly insensitive to changes in the cost of fuel, there have been recent rises in the uranium price, and this has increased exploration and production. Known uranium reserves now represent 100s of years of supply at current rates of consumption[12]. *(See Factsheet "How does nuclear contribute to security of supply?" for more details.)*

Life-cycle analysis

Energy and raw materials are also required to construct power plants. The below figure shows the cumulated life-cycle energy requirements (excluding fuel for operation) of different technologies[13, 14].



Cumulated energy consumption (excluding fuel for operation) for various technologies (Source University of Stuttgart)

Peak load response

Nuclear power plants typically run as base-load plants: they are used to meet a given region's continuous energy demand (as are coal-fired plants). Although new nuclear plants are capable to respond to weekly and to some extent even daily load changes, they still remain – due to their construction – relatively slow to respond[15]. Peak load responses are usually managed by water pump plants or gas- and oil-fired plants.

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